

## **Historic, archived document**

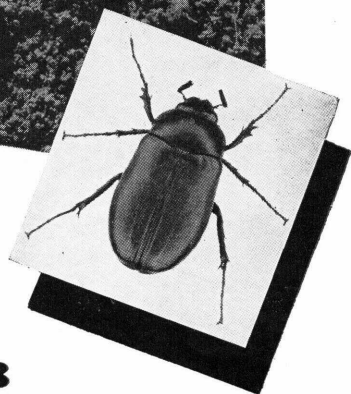
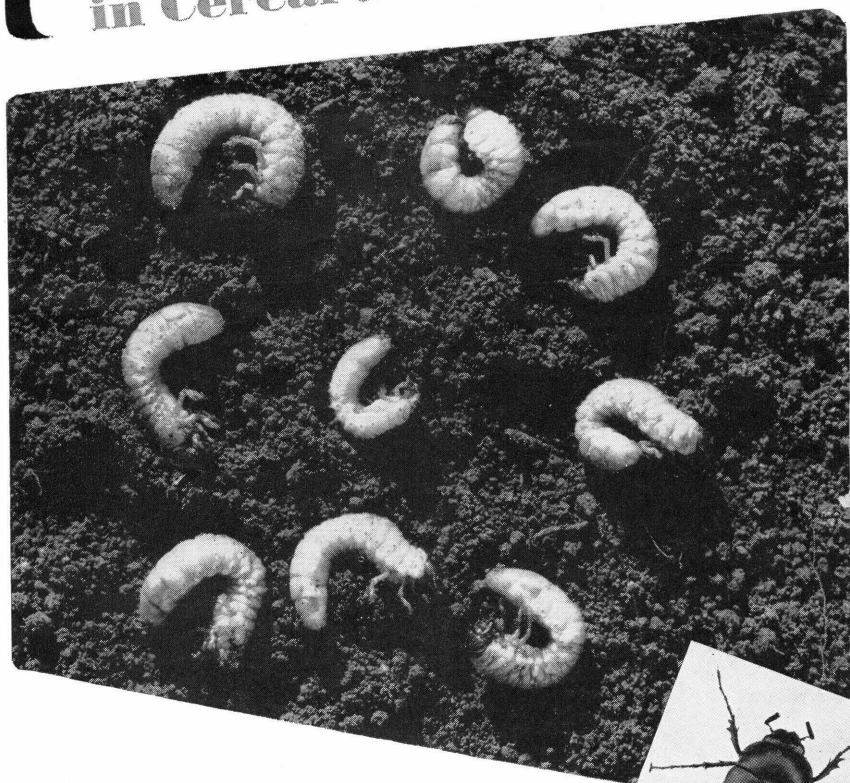
Do not assume content reflects current scientific knowledge, policies, or practices.

1  
ag 84F  
clip 6



# Control of Common White Grubs

in Cereal and Forage Crops



**Farmers' Bulletin No. 1798**

U. S. DEPARTMENT OF AGRICULTURE

## CONTENTS

	Page
Broods of May beetles.....	2
Life history of May beetles.....	3
Grubs likely to be mistaken for white grubs.....	4
Natural enemies.....	8
Where to look for grubs.....	9
Farm practices that will control white grub.....	9
Cropping practices.....	9
Plowing as a control measure.....	10
Renovation of pastures.....	11
Control with hogs and poultry.....	12
Control of grubs with insecticides.....	12
Control of May beetles.....	13

# CONTROL OF COMMON WHITE GRUBS IN CEREAL AND FORAGE CROPS

By PHILIP LUGINBILL, Sr.,<sup>1</sup> and T. R. CHAMBERLIN,<sup>2</sup> entomologists, Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration

**C**OMMON WHITE GRUBS, the young of May beetles (*Phyllophaga*), frequently destroy large acreages of many farm crops by eating the roots and other underground parts of the plants. In some years losses caused by damage to corn, timothy, and potatoes in

Indiana. These grubs are also serious pests of grass pastures and nursery plantings. They may also damage lawns and golf courses. The adult beetles eat the leaves of many kinds of trees; sometimes they strip the timber on farm wood lots.



FIGURE 1.—A corn hill destroyed by white grubs.

the North Central States alone reach several million dollars. From 12 to 17 grubs may be found in a single hill of corn (fig. 1). Such an infestation may destroy the crop completely. In recent years damage to soybeans (fig. 2) or to corn following soybeans in a rotation has been a problem in Illinois and

Outbreaks of white grubs have occurred in some of the North Central States every third year for nearly 50 years. During the early outbreaks injury was reported from almost every section north of the Ohio River and westward to South Dakota, but in recent years the damage has been less general.

<sup>1</sup> Retired Sept. 30, 1950.

<sup>2</sup> Retired Oct. 31, 1950.



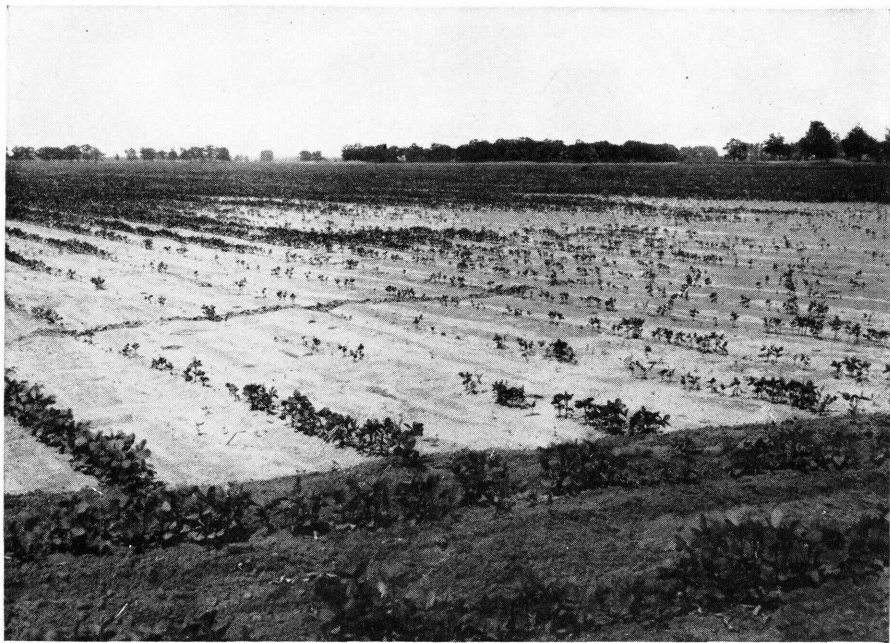


FIGURE 2.—Soybeans severely damaged by white grubs in Jasper County, Indiana, 1946.

### BROODS OF MAY BEETLES

There are more than 100 different kinds of May beetles. Some of them are more injurious than others. In the region where the grubs do the most damage most of the injurious species have a 3-year life cycle, which accounts for the 3-year cycle of outbreaks. However, a brood of

adults emerges in each year of the cycle. These broods have been designated as A, B, and C. Brood A (fig. 3) is by far the most abundant and is the one present in outbreak years. Brood B is usually unimportant, but brood C (fig. 4) is sometimes injurious in certain areas.

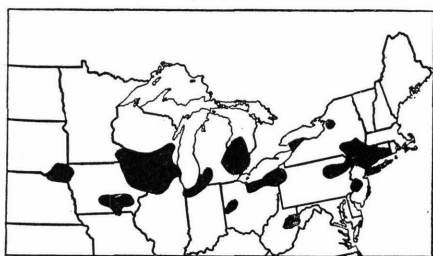


FIGURE 3.—Map showing districts of greatest abundance of brood A of May beetles.

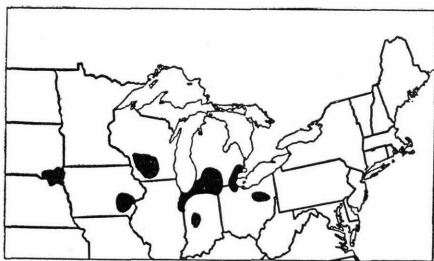


FIGURE 4.—Map showing districts of greatest abundance of brood C of May beetles.

## LIFE HISTORY OF MAY BEETLES

May beetles emerge from the soil in the spring and lay their eggs a few inches below the surface (fig. 5). They place the eggs within balls of earth that they have formed and held together with a sticky secre-

tion. After 3 or 4 weeks the eggs hatch into white grubs.

The grubs feed for the first season on decaying vegetable matter in the soil and also attack living roots. Late in the fall they burrow deeper

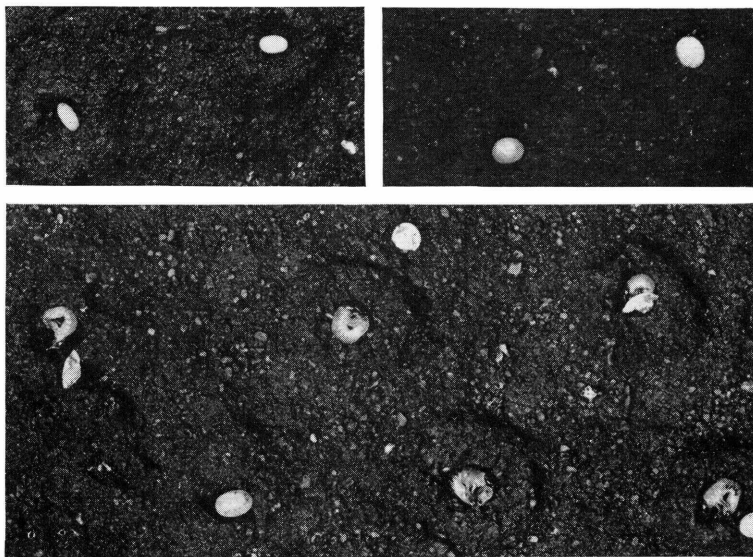


FIGURE 5.—Eggs of May beetles in their soil cells: Upper left, immediately after deposition; upper right, 6 or 7 days later. Below, white grubs hatching.

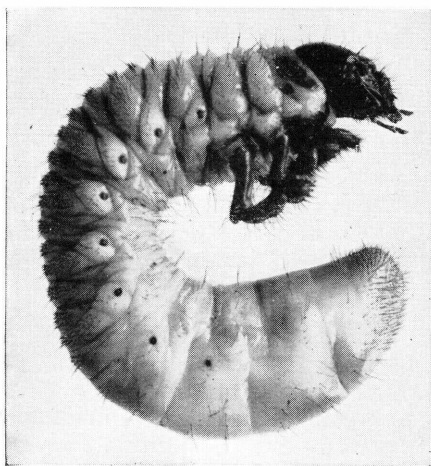


FIGURE 6.—A full-grown white grub, enlarged.

into the ground, where they remain inactive during the winter. The following spring they come up near the surface again and feed on the roots of plants. They do their greatest damage in this their second year. In the fall they again go deep into the soil, to return in the spring, some of them to feed on the plant roots until about June. By this time the grubs are full-grown (fig. 6). Then they prepare earthen cells in the ground in which to change to the inactive pupal stage (fig. 7). A few weeks later the pupae change to adult beetles, but they remain in the pupal cells over another winter, and then emerge from the ground to lay eggs for the next generation. (See fig. 10.)



The time when the beetles appear depends on the latitude. In Indiana and southern Wisconsin they are most abundant during the last 2 weeks of May, but they may be found any time between the first of May and the middle of July. In more southern latitudes they appear about a month earlier. Farther north, particularly in Canada,

they are most numerous in June and are called June beetles.

The beetles eat the leaves of many kinds of trees, especially oak (figs. 8 and 9), elm, hickory, ash, poplar, willow, locust, hackberry, walnut, and pine. Some species also feed on nonwoody plants, particularly such weeds as curly dock, cinquefoil, and wild sunflower.



FIGURE 7.—A May beetle pupa in its cell.

### GRUBS LIKELY TO BE MISTAKEN FOR WHITE GRUBS

Many people believe that the white grubs seen in the field are the same as similar grubs often found in manure heaps and rotten logs. The grubs of May beetles are not known to breed in manure or any other kind of refuse. The grubs found most commonly in manure in the Northern States are the larvae of certain brown beetles which, like the May beetles, are attracted to lights, but do not feed on plant foliage. The grubs of May beetles have a double row of spines along

the under side of the last body segment, which helps to distinguish them from other grubs living in similar habitats.

Another grub often mistaken for that of a May beetle is the larva of the green June beetle, known to scientists as *Cotinis nitida*, which sometimes injures grass and other vegetation, including alfalfa, in the Southern States and along the Atlantic coast as far north as Long Island, N. Y. Recently it has been a serious pest of Ladino clover in





FIGURE 8.—A bur oak wood lot defoliated by May beetles.

southeastern Virginia. This grub seems to prefer soils fertilized with animal manures. Unlike the common white grubs, it makes burrows that open at the soil surface. It has a peculiar habit of crawling on its back when placed on the ground.

However, it is much less injurious to field crops than are the common white grubs. Occasionally it damages golf courses by making small mounds of earth, which interfere with play and cover the grass with mud during wet weather.

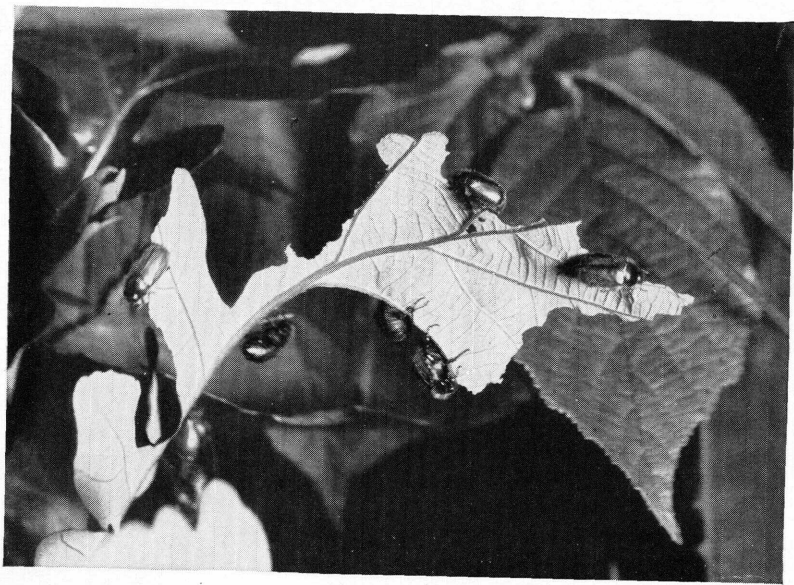
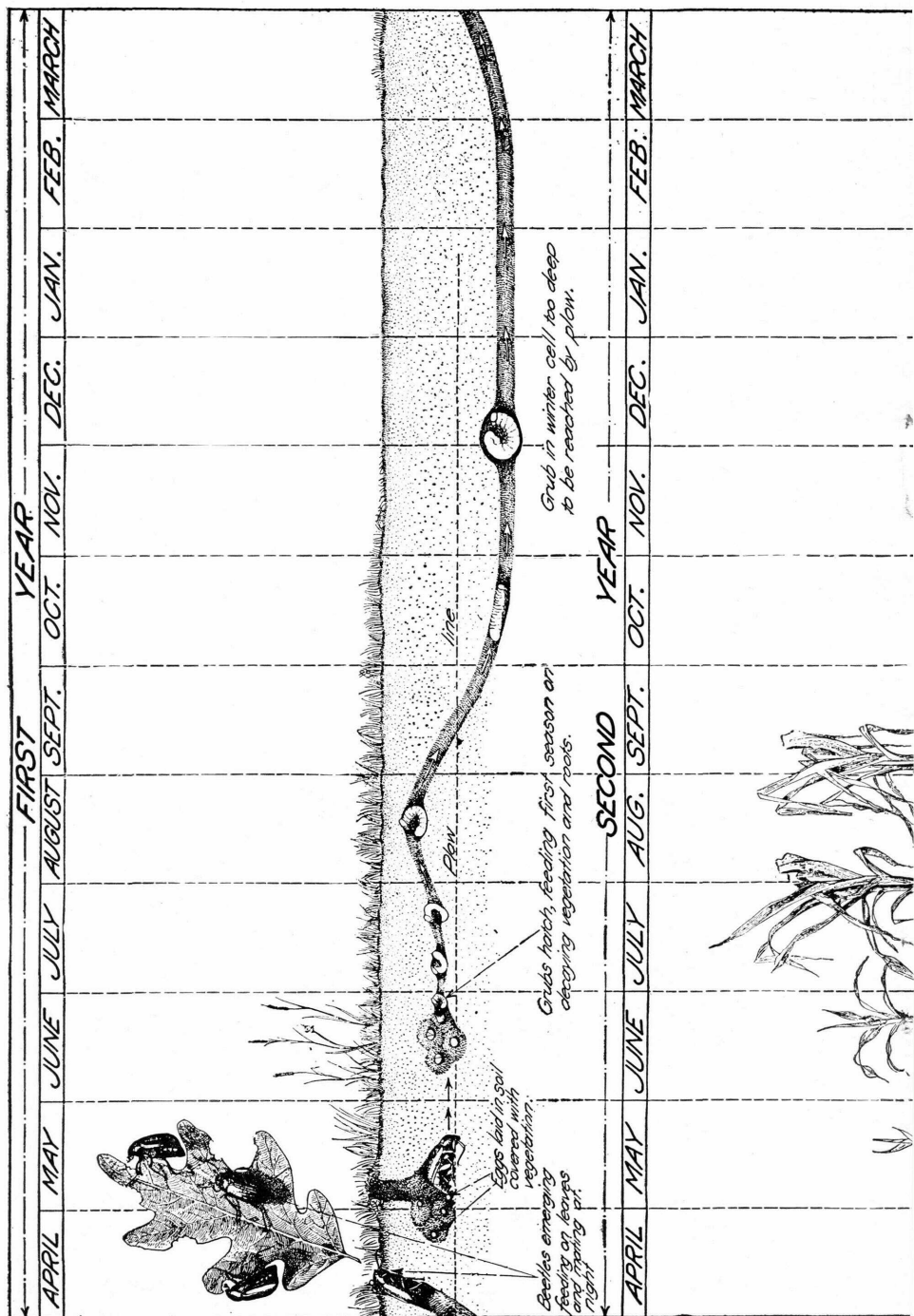


FIGURE 9.—May beetles feeding on a white oak leaf.





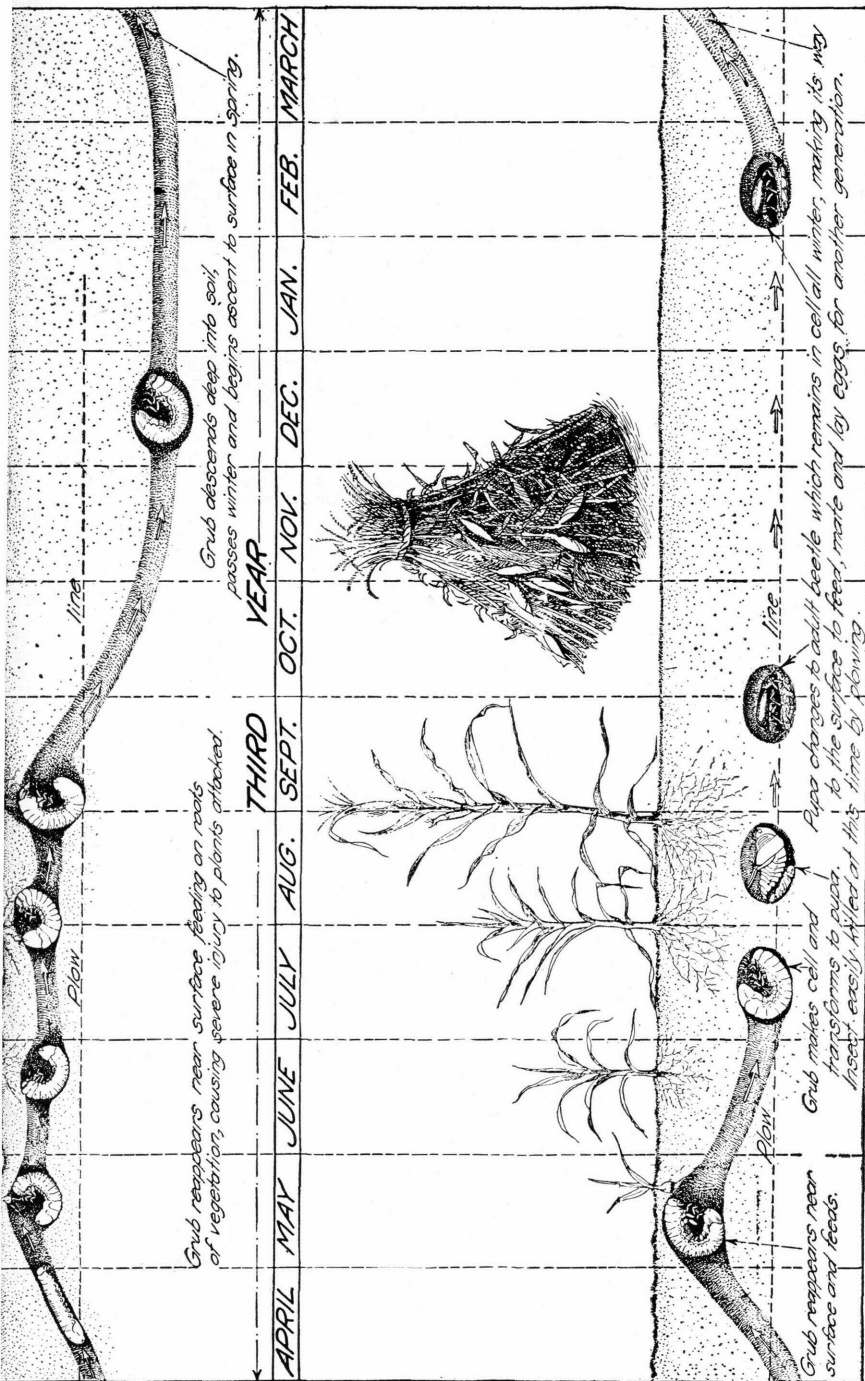


FIGURE 10.—Diagram illustrating the usual life cycle of white grubs. (Courtesy of the Wisconsin Agricultural Experiment Station.)



Two species of *Cyclocephala* have sometimes appeared in destructive numbers in lawns and grassy areas. These grubs can be recognized by their bluish cast and the irregular arrangement of the spines on the under side of the last body segment. Their life cycle is completed in 1 year. The adults appear in July, after the May beetles have disappeared, and they do not feed on the foliage of trees and shrubs as do May beetles.

Other kinds of grubs sometimes confused with larvae of the May beetles are those of the Japanese beetle, common in some sections of the Eastern States, and of the white-fringed beetle, found in the Southeastern States. The Japanese beetle grubs are smaller than the common white grubs. White-fringed beetle grubs are yellowish white and legless.

If in doubt as to what kind of grubs are present in your soil, submit specimens to your State agricultural experiment station for identification.

## NATURAL ENEMIES

White grubs and May beetles are preyed upon by numerous birds, animals, and insects. Probably the most helpful in this respect are the birds, especially crows and grackles and, in some localities, gulls. Fields of timothy sod have been literally overturned by crows in their search for grubs and in some fields the grubs have been almost exterminated by them. Grackles have often been observed following the plow, eagerly picking up every grub that was unearthed. All farm fowls eat these insects, but especially turkeys. Oppossums and especially moles and skunks also feed on white grubs.

Among insect enemies of the grubs are certain wasps, bee flies, and robber flies. The wasp larva (fig. 11), which feed on and destroy

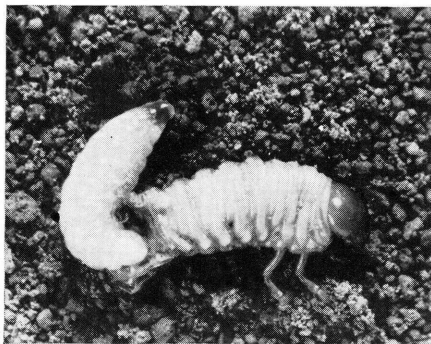


FIGURE 11.—Larva of a wasp attacking a white grub.

the grubs, when full-grown, form brown cocoons in the soil (fig. 12), which are frequently turned out by the plow. The robber fly larvae are slender and shiny white and about 1½ inches long when full-grown. The adults prey on other insects. Some parasitic flies attack the beetles depositing their eggs within the body of the beetle. The larva hatching from the egg gradually kills the beetle.

Fungus diseases sometimes attack the grubs or beetles, and when conditions are favorable these diseases no doubt serve as natural checks.

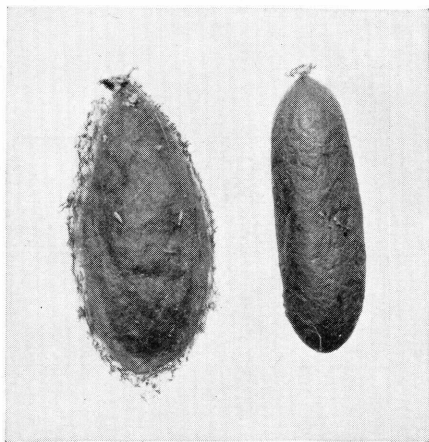


FIGURE 12.—Cocoons of *Tiphia* (left) and *Ellis* (right) wasps, parasites of white grubs.

## WHERE TO LOOK FOR GRUBS

May beetles usually deposit their eggs in ground covered with vegetation near timber on the higher parts of the land. Therefore, you are most likely to find the grubs in sod on the higher parts of fields of timothy and bluegrass near wooded tracts, or in ground that was in one of these crops the previous year, or was covered with vegetation other

than deep-rooted legumes during the flight of the beetles. The short, dense growth of grass on lawns is also favored for egg laying. Sometimes infested turf rolled back like a carpet, exposes large numbers of grubs (fig. 13). As many as 11 grubs have been found in 1 square foot of soil.

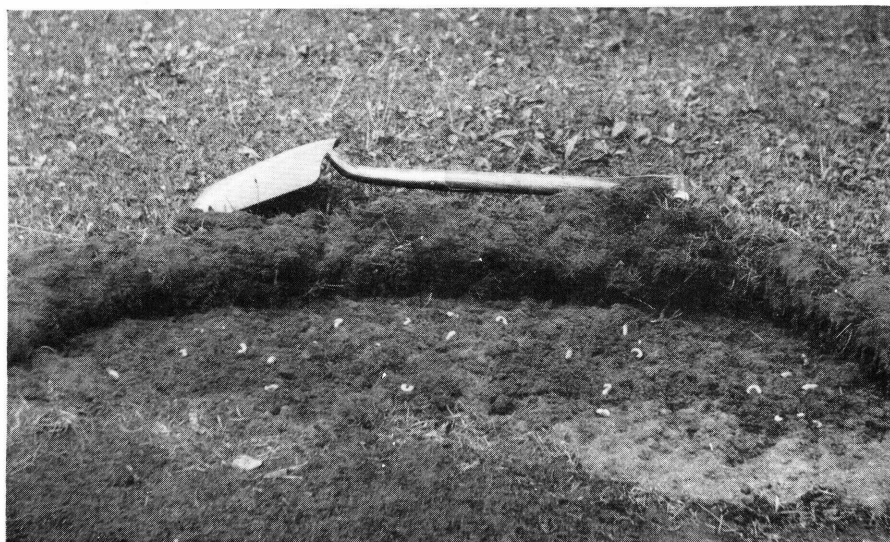


FIGURE 13.—A piece of sod overturned to show the white grubs underneath.

## FARM PRACTICES THAT WILL CONTROL WHITE GRUBS

There are no satisfactory means of destroying the white grubs that are present in large fields of growing crops. However, certain farm practices, if carefully carried out, will greatly reduce the damage in succeeding years.

### Cropping Practices

White grubs feed on a wide range of garden and field crops, as well as grasses and nursery plants. Some plants are severely damaged, others are occasionally attacked, and some rarely show evidence of feeding. All crops, however, are more susceptible in the seedling stage.

Agricultural crops may be grouped as follows according to their susceptibility to attack:<sup>3</sup>

*Susceptible:* Timothy, red top, Kentucky bluegrass, corn, strawberries, and potatoes.

*Moderately resistant:* Barley, oats, wheat, rye, beans, turnips and carrots.

*Very resistant:* White Dutch clover, red clover, alsike clover, peas, orchard grass, buckwheat, and sunflowers.

*Extremely resistant:* Alfalfa and sweetclover.

<sup>3</sup> Hammond, G. H. 1940. White Grubs and Their Control in Eastern Canada. Canada Dept. Agr., Div. Ent., Science Service, Pub. 668 (Farmers' Bul. 86), 18 pp.

In areas where the grubs are prevalent, resistant crops can be grown where susceptible crops would fail. Since low, wet soils are less heavily infested than soils on higher land, plant susceptible crops in such soils, provided they grow well there. Such crops include corn and timothy. Plant crops that are resistant to white grubs on the higher land. Early varieties of canning peas can be grown successfully on badly infested land. Sweetclover will grow on poorer soils than will alfalfa, provided such soils are not low in lime.

Crop damage can be reduced by using a rotation of resistant and susceptible crops—for example, a rotation of deep-rooted legumes such as alfalfa, sweetclover, or red clover, with corn, small grains, or grasses.

To gain the most benefit, sow the legumes in the years when beetle flight is heaviest, which is when the beetles of brood A emerge. In these years the eggs are laid, small larvae appear early in the summer but do little damage, and if the stand of legumes is clean—free from weeds and grass upon which the grubs may feed—most of the grubs will die before winter.

In areas where the flight of both broods A and C is heavy, plant the legumes in the year when brood C is in flight, for the larvae of this brood will be small and meet the same fate as described for brood A. Brood A grubs will be in their third year and do little feeding. If you plant legumes in these areas in the year brood A emerges, the seedlings will be attacked by second-year grubs of brood C.

In general, in areas where grubs are prevalent, do not plow sod fields for planting any susceptible crop in the year following a major flight of May beetles. This is the year in which the grubs feed most heavily,

and they cause damage to the new crop, even to seedlings of legumes. In this year plow and plant to crops only fields that were in legumes or some clean-cultivated crop such as corn or potatoes. If you must plow grassland in a year of major beetle flight, plant only resistant crops. Sod may contain a high grub population.

Where it is impossible to follow such a rotation, grow deep-rooted legumes as much as possible and follow them with clean-cultivated crops, but practice strip-cropping or terracing where erosion is a problem.

When white grub damage occurs in fields in which the rotation for several years has consisted of soybeans and corn, use a longer rotation including other crops.

Every farmer whose lands are subject to grub attack should learn the years in which major beetle flights occur, the years in which the grubs do the most damage, and the particular fields on his farm that are more commonly infested. He should give these fields special care and crop them in a rotation designed primarily to control the grubs. Some fields that are lightly or only rarely infested do not need to be placed in such a rotation.

### **Plowing as a Control Measure**

Ordinary spring and fall plowing will not control white grubs. Most of the spring plowing is completed before many of the grubs are within plowing depth, and fall plowing is done after many of them have descended below that depth. Moreover, few of the grubs uncovered are cut by the plow, and many of them escape into moist soil.

Plowing late in the spring or early in the fall may destroy some of the grubs that are near the surface, if the plowing is shallow and done when the top soil is hot and



dry. Shallow plowing at such times followed by disking has been suggested as a control measure.<sup>3</sup> The ground should be disked several times, each disking being cross-wise to the preceding one. If the soil is hot and dry, exposure to the heat will quickly kill many grubs, but if it is moist and cool the disking must be more thorough, for only the grubs crushed or cut with the plow or disks will be killed. In land free of stones shallow plowing with a rotary plow should be as effective as plowing and disking.

Plowing in August of the year before a major flight has also been suggested for the control of white grubs. At this time the grubs are in the pupal stage, when they are most easily destroyed, but most of them are below ordinary plowing depth, and the soil is usually so dry that deep plowing is especially difficult. Soils menaced by erosion in particular should not be plowed deeply in August. Moreover, most

of the infested area would have to be plowed to reduce beetle emergence materially.

### Renovation of Pastures

Grub damage is generally slight in permanent bluegrass pastures that are well cared for, improved by the use of proper fertilizers, and not overgrazed. Pastures on rich, moist bottom lands usually show little injury. On the other hand, egg laying by May beetles may be heavy in pastures on hilly, rocky land near woods. On such land the soil is likely to be thin and dry, especially when feeding by grubs is heaviest (fig. 14).

Pastures impoverished by overgrazing, lack of soil fertility, and grub damage may be renovated in a short time. You can obtain instructions applicable to your particular area from your county agent or State agricultural experiment station, but in general the renovat-



FIGURE 14.—A bluegrass meadow seriously damaged by white grubs.

ing process includes the following steps:

(1) Prepare a good seed bed by tearing up the sod with a disk, spring-tooth harrow, or field cultivator. Do this once or twice in the fall after the grass has stopped growing and again in the spring before growth starts.

(2) Apply fertilizer and lime in the amounts that soil tests show to be needed.

(3) Sow a mixture of legumes and firm the seedbed with a cultipacker or roller. A mixture of 12 to 15 pounds of common biennial white sweetclover and

5 pounds of red clover per acre has been found suitable for some localities.

(4) Fence off the renovated area so that grazing can be regulated. Moderate grazing may be permitted during July and August of the year of seeding, when bluegrass pastures are usually unproductive. However, withhold grazing during September and October, or until growth has been retarded by frost. Light grazing thereafter will cause little damage to the legumes. The bluegrass will come back vigorously after the legumes have been established.

## CONTROL WITH HOGS AND POULTRY

It is often worth while to pasture hogs on grassland or in fields of other crops after they have been harvested. Grubs are generally concentrated in injurious numbers in parts of a field. Hogs readily discover these heavily infested areas and root out the grubs and eat them. They also feed on the beetles that they find in the ground. Fields that hogs have pastured thoroughly may be planted to crops the following year, provided soil-conserving measures are used

on land subject to erosion.

Do not pasture hogs on bluegrass unless the field is to be plowed for other crops or renovated, as their extensive rooting may injure the sod.

Do not pasture hogs in the same field oftener than once in 3 years, for white grubs are the intermediate host of the giant thorn-headed worm of swine.

Allow hogs and also turkeys and chickens the run of the field while you are plowing or disking.

## CONTROL OF GRUBS WITH INSECTICIDES

On lawns and golf courses it is often profitable to apply an insecticide to control white grubs. Lead arsenate and chlordane are suitable for this purpose. You can apply either of them as a dust or a spray. For treating small lawns a dust is more satisfactory.

Use **lead arsenate** dust at the rate of 10 pounds to 1,000 square feet, or 450 pounds per acre. Prepare a spray by adding 1 pound to each 2 gallons of water and apply at the rate of 20 gallons per 1,000 square feet of turf, or 900 gallons per acre.

**Chlordane** can be applied as a 5- or 10-percent dust at a rate to give 10 pounds of the active agent per acre, or as a spray made from a

wettable powder or emulsifiable concentrate to give the same dosage.

**Aldrin** and **BHC** are also effective against white grubs, but additional research is needed to establish their most effective dosages. Consult your county agent or State agricultural experiment station for the latest recommendations on the use of these materials.

Apply dusts with a fertilizer distributor or spreader (fig. 15), or broadcast by hand. To obtain uniform distribution, mix the dust with sand or dry soil. Apply sprays with any standard spray equipment. Wash the insecticide well into the soil. After applying lead arsenate or chlordane to the turf, you can mow, water, and fertilize as usual.

**Caution.** In using any insecticide for white grub control, follow carefully all directions given on the container. Do not inhale the dust or spray. Wear gloves while doing the work and change your clothes if you spill any of the insecticide on them. Store

insecticides in plainly labeled containers, away from food, and out of reach of children and pets.

Do not feed any vegetation contaminated with these insecticides to dairy animals or to animals being fattened for slaughter.



FIGURE 15.—Dusting a lawn with a fertilizer distributor.

## CONTROL OF MAY BEETLES

It is usually not practical to attempt control of adult May beetles feeding on trees or shrubbery, although both lead arsenate and DDT have been used for that purpose. For a spray use 2 pounds of lead arsenate plus 1 pound of wheat flour or the recommended amount of a good proprietary adhesive, or 8 ounces of a 50-percent DDT wettable powder, in 25 gallons of water. Although it is less satisfactory than a spray, you may apply DDT as a 5-percent dust.

In some parts of the South, as in southern Texas, certain species of the May beetles are wingless. They crawl from field to field and seriously damage field and garden crops. You can control such beetles with a poisoned bait. Mix thoroughly 20 pounds of wheat bran, 1 pound of paris green, and 1 quart of corn sirup. Grind 3 lemons and add them to the mixture. If necessary, add sufficient water to dampen the mixture thoroughly. Broadcast at the rate of 7 to 10 pounds per acre just before dark.



When the beetles are moving from one field to another it is sometimes practical to trap them in deep furrows plowed across their path. Smooth the bottoms of such furrows and leave the sides loose to prevent the beetles from climbing

out. Post holes may be dug in the bottom of the furrow at intervals of 15 to 20 feet into which the beetles fall; they can then be easily destroyed. Scatter the poisoned bait along the edges of the furrow to hasten the kill of beetles.